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A HEARTBEAT DETECTION METHOD BASED ON IOT AND MONITORING SYSTEM USING ARDUINO UNO AND THING-SPEAK

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ABSTRACT

In the field of bio-signal monitoring, the demand for integrating sensing and telemetry devices has increased significantly. The available technology has allowed the doctors to monitor the patient in real time from anywhere over the internet. This have helped both doctors as well as patients and brought a revolution in patient health monitoring system. In this project, an Arduino based Heartbeat Monitoring and Detection system has been designed. It allows us to monitor the heartbeat of a person over the internet. Heart-rate is a very vital health parameter because it has use in determining the health of the cardiovascular system of the patient. The designed IoT system is integrated with the heartbeat detector and automatically updates the heartbeat of the patient over the internet.

KEYWORDS: Photo-Plethysmography, IoT, Bio-Medical Signal, Thing-Speak, Health Monitoring & Care System

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Original Article

INTRODUCTION

In this paper patient's temperature, their body movement, respiration and heartbeat have been monitored using Raspberry Pi. Raspberry Pi receives the signals from the sensors through amplifier circuits and signal conditioning unit. Since the gain level of signal is very low so amplifier circuit increases the gain. The biomedical signals of the patient can be monitored from anywhere around the world over the internet **[1-2].** In this paper the patients pulse rate is monitored using an infrared detector, which is a non-intrusive method. The near-real-time biomedical signal provided by the sensor is displayed as waveform. In this paper an Android application has been developed which shows the ECG signal of the user and is based on IoT and cloud computing**[3-5].** The application allows the user to upload their data on to their personal cloud storage or to some medical cloud so that the data can be easily monitored by the doctor and can be easily retrieved whenever deemed necessary.

This paper also deals with the infrastructure for healthcare domain **[6-8].** The heartrate of the patient is measured via optical technology by detecting the flow of blood via index finger. The pulse from the fingertip has been detected in three phases which are – detecting the pulse, extracting the signal and lastly amplifying the pulse signal. The obtained data has been compared with ECG measurements and by measuring the pulse rate with manual methods **[9-12]**.

In this paper the heartbeat rate is measured using infrared transmitter and infrared sensor. Op-Amp LM358 is used to amplify and filter the pulse signal given by infrared sensor. The amplified as well as filtered signal obtained is then analysed with the help of PIC16F628A microcontroller which determines the number of pulse over a time interval. A number of readings are taken and averaged to give a more accurate reading of heartrate. The developed system is very cost efficient and simple **[13-14]**. A build in device, which is a wrist band, has been worn

by the patient on wrist. This device measures pulse rate, peak systolic pressure and baseline systolic pressure. If any drastic change is recorded by the device, it sends a message to the user's mobile phone or any other mobile phone. The device is connected to the android smartphone via Bluetooth or WLAN. The user needs to download an app in the android mole phone. The app contains the contacts which should be contacted via message during emergency **[15]**. In this paper a near-infrared heart-rate measurement IC has been designed. The proposed device measures the photo-plethysmography signal. In the designing of this device a 0.35-/spl mu/m CMOS technology has been used. The IC consists of a comparator, a buffer, a continuous time low-pass filter (CT-LPF), a sample and hold circuit, a current-to-voltage (I-V) converter, and a timing circuit. In this paper, current steering technique is used for designing the CT-LPF that is why there is a very low cut-off frequency **[16]**.

METHODOLOGY

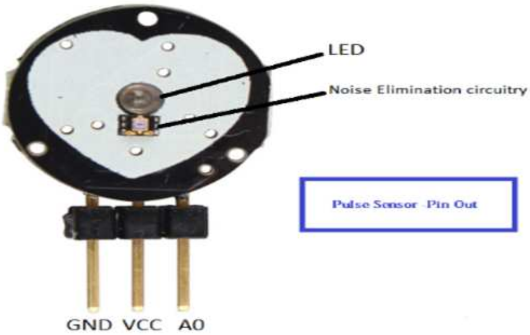

Figure 1: Pulse Sensor

First the Pulse Sensor is attached to any organ of body where it can detect the pulse easily like finger. Then the used Sensor measures the change in volume of blood, which occurs when every time blood in the body is pumped by heart. The light intensity through the organ of body changes corresponding to the change in volume of blood in that organ. The software then converts this change into beats per minute (BPM). The LED which is connected at pin 13 also blinks per the heartbeat. Pulse sensor has three pins. Connect 5V and the ground pin of the pulse sensor to the 5V and the ground of the Arduino and the signal pin to the A0 of Arduino. A PPG based pulse sensor is given in Figure 1.

The ESP8266, which is shown in Figure 2, communicates with the Arduino and sends the data to Thing-Speak. This data on the Thing-Speak is displayed in a graph form showing the past readings too and can be accessed from anywhere over internet. The LCD connected also show the BPM.

ESP8266 requires 3.3V and if the Arduino Uno board provides it with5V then it will not function properly and it might get damaged. Connect the CH_PD and the Vcc to the 3.3V pin of Arduino. The RX pin of ESP8266 requires only 3.3V and it does not respond to the Arduino when it is connected directly to the Arduino. So, a voltage divider for it is made which converts the 5V into 3.3V. This can be done by connecting three resistors arranged in series. Connect the TX pin of the ESP8266 to the pin 9 of the Arduino and the RX pin of the ESP8266 to the pin 10 of Arduino through the resistors.

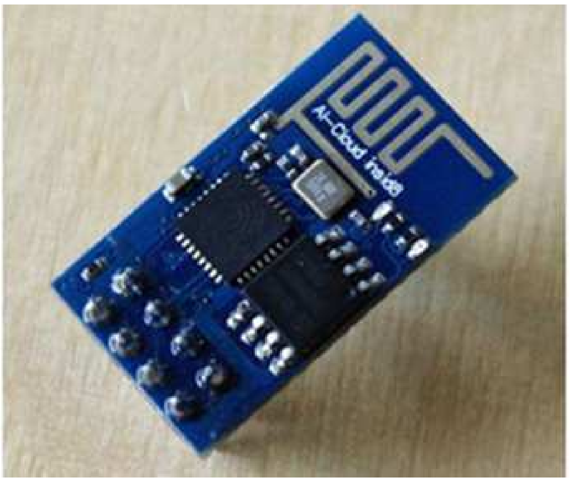

Figure 2: Wi-Fi Module (ESP8266)

The Arduino Code is used for

- To setup the Wi-Fi name, Wi-Fi password and IP address of the Wi-Fi module ESP8266 and the API key of Thing-Speak.
- To read the sensor and to convert the output of the sensor into BPM. Also, blink the LED connected at the pin 13 per the BPM.
- To start the LCD.
- To set up the baud rate per the ESP8266. (either 9600 or 115200)
- To transmit data at the IP address and to manage the fields we have set up for heart beat.
- To connect the ESP8266 Wi-Fi Module with the Wi-Fi network and then to use this network to send the data to the Thing-Speak.

Some of the Key Capabilities of Thing-Speak Include the Ability to

- Easily configure a device to send data to Thing-Speak using required IoT protocols.
- Visualization of sensor data in real-time.
- Aggregate data on-demand from third-party sources.
- Use the power of MATLAB to make sense of your IoT data.
- Run your IoT analytics as per the schedules.
- Develop and use IoT systems without setting up servers or developing any web software.
- Automatically act on your data and communicate using third-party services like Twilio® or Twitter®.

Block Diagram of the Complete System is shown in Figure 3.

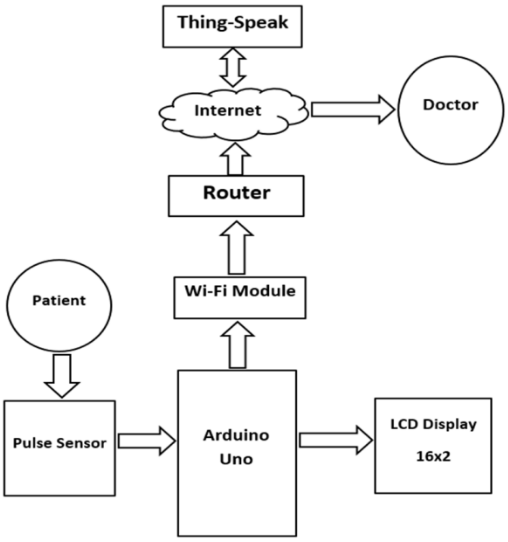

Figure 3: Block Diagram of Proposed System

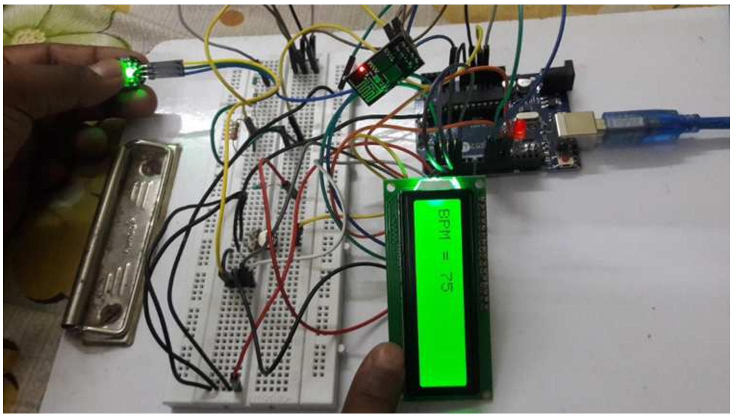

Figure 4: Proposed Device

RESULTS AND CONCLUSIONS

The heartbeat taken is displayed on LCD monitor as shown in the Fig.4 and displayed over internet at Thing-Speak. Output over the internet can be viewed by searching the particular channel at the public channel section of the Thing-Speak website by searching for tags such as Heartbeat monitor, Internet of things or Photo-plethysmography over the link (https://thingspeak. com/channels/public). The LED also blinks as per the corresponding heartbeat. The Wi-Fi module in this device can be automatically connected to only that Wi-Fi network, whose Wi-Fi network name and password is known and present in the program embedded in the Arduino Uno. Although Wi-Fi network can be changed, if required, by changing the name as well as password of the Wi-Fi network in the main program and embedding it again into the Arduino Uno board. Otherwise, the program can also be developed in such a way that the Wi-Fi network can be chosen from the available Wi-Fi networks in that area by making minute changes in the program and adding a monitor with the system. The device can be further improved by interfacing various other biomedical sensors with Arduino. The data obtained can be sent via Think-speak to any personal cloud storage or the cloud storage of a hospital for easy access by the doctors.

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